EREM 78/1
Journal of Environmental Research, Engineering and Management
Vol. 78 / No. 1 / 2022
pp. 70–82
DOI 10.5755/j01.erem.78.1.29537

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Received 2021/08 | Accepted after revision 2021/12

http://dx.doi.org/10.5755/j01.erem.78.1.29537

Rural Waste Management System in Southern Zone of Gunungkidul Regency

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The lack of waste services in rural areas forces locals to process waste conventionally and eventually damage the environment. Solid waste management in the rural area of developing countries has been less documented widely, in contrast to urban areas. This paper presents the descriptive analysis of rural solid waste management in the Southern Zone of Gunungkidul Regency (SZGR) that has grown in population and economy due to tourism development and accessibility quality improvement. The field survey was conducted in 18 randomly selected villages. 43 key informants were given structured questions related to operational, regulation, institutional, financing, and community participation in the waste management system. Relevant documents and reports were collected from relevant agencies. Primary and secondary data in the form of text, tables, graphs, and images were then analysed by qualitative descriptive analysis. The results showed that the locals manage their waste by burning and dumping it in the backyard and illegally stockpiling. This conventional processing is due to the absence of regulations governing waste management at the village level. The organization responsible for waste management is The Cleanliness and Landscaping Technical Executor Unit. They only serve and collect levy fees in tourist areas and several public markets. Locals need socialization and assistance so that they can be independent in waste management. The

rural solid waste management system in the SZGR has various weaknesses in every aspect. The formulation of ideal rural solid waste management requires a different approach from urban areas. Socio-cultural conditions and characteristics of the waste produced can be a consideration and further research.

Keywords: waste management system, rural areas, solid waste, Gunungkidul Regency, domestic waste.

Introduction

Rural areas in developing countries experience the same solid waste management problems as urban. However, rural waste services tend to be neglected by local governments. The average waste service in Indonesian rural areas is 4.65% although more than 80% of Indonesia's territory is rural (Indonesia, 2020; Worldometers, 2021). This condition indicates a significant dichotomy between waste management organizations in rural and urban areas (Boateng et al., 2016). When waste management in cities in Asia is considered unsatisfactory (Taweesan et al., 2017), conditions in rural areas will be interesting to document. The solid waste management system consists of operational, regulation, institutional, financing, and community participation (Badan Standarisasi Nasional, 2008). Every aspect of the waste management system has a mutually influencing relationship. Solid waste stakeholders have roles and responsibilities to achieve effective and efficient solid waste management (Guerrero et al., 2013). Weaknesses in one or more aspects will cause the system not to go well. Poor waste management is a barrier to environmental sustainability (David et al., 2019). It can harm the environment and human health, thereby reducing productivity and economic growth (Serge Kubanza and Simatele, 2019).

Research in recent years reveals the characteristics and technical aspects of waste management in rural developing countries. Rural areas in Iran (Taghipour et al., 2016; Darban Astane and Hajilo, 2017; Vahidi et al., 2017), Romania (Ciuta et al., 2015), Egypt (Anwar et al., 2018), China (Han et al., 2015), and Thailand (Suma et al., 2019) have a different waste generation level and compositions compare to urban areas. Rural households produce waste ranging from 0.4 kg day^{-1} to 0.588 kg day^{-1}, while urban households in 20 countries generate solid waste of 3.4 kg day^{-1} on average (Programme, 2010). Organic waste is of a common composition in rural areas compared with inorganic waste. Waste originating from rural areas in China has a high organic content composition and low recyclable waste (Han et al., 2019). Waste management in rural areas tends to be done by the community conventionally. Various conventional methods, such as burning, being buried in the backyard, piling up around the village, or providing organic waste for animal feed, are commonly practiced by the locals (de Morais Lima and Paulo, 2018; Chen et al., 2019; Nxumalo et al., 2020).

The government has a role to provide waste infrastructure and implementing organizations, and formulate solid waste management policies. Governments in developing countries generally have a small allocation of budgeting to accommodate the waste infrastructure and human resources optimally (Bundhoo, 2018; Cetrulo et al., 2018; Paul et al., 2019). The development of waste disposal infrastructure is essential for environmental protection because it provides convenience for the community and encourages correct disposal behaviour (Wang et al., 2018). The lack of funding in solid waste facilities also exacerbates the rural waste problems (Wang et al., 2017; Chen et al., 2019). The solid waste management organizations provided by the government require skilled personnel to work. Unprofessional human resources will hinder waste services at every operational stage. Waste remaining in the collection stage will result in open dumping and waste burning (David et al., 2019).

The performance of government waste management organizations faces many obstacles. Transferring resources and authority to the local level accompanied by clear guidelines and strategies to strengthen local management processeses can improve those obstacles. The development of an effective solid waste management system requires an organization that has authority at the community level (Serge Kubanza and Simatele, 2019) and good public-government partnerships (Spoann et al., 2018). Waste management policies require continuous efforts (Sivakunakorn et al., 2014). Committed violations that have the potential to harm the environment need to be dealt with firmly (Cetrulo et al., 2018). Weak rule enforcement will

damage the rhythm of waste management implementation (David et al., 2019). The institutional performance and policy implementation fiasco cause ineffective waste management (Serge Kubanza and Simatele, 2019).

Ineffective solid waste management is a challenge for local governments and needs to be solved with a holistic approach because this is a multidisciplinary problem (Paul et al., 2019). For the successful solid waste management system, the social aspect needs to be considered. The waste management operational stage is less complicated if the community is willing to sort waste before disposal (Suma et al., 2019; Wang and Hao, 2020). The community and third parties involved are patching the weaknesses of government organizations (Spoann et al., 2018; Serge Kubanza and Simatele, 2019). Even the policies implemented by the government will not succeed without the participation of the community (Cetrulo et al., 2018). The importance of the role of the community is one aspect of the solid waste management system, whose participation and awareness need to be improved.

Gunungkidul Regency has the biggest rural administrative area in DI Yogyakarta (Gunungkidul, 2020a). The Southern Zone of Gunungkidul Regency (SZGR) is experiencing rapid economic growth due to tourism development in coastal areas and part of the Gunung Sewu UNESCO's Global Geopark (Masjhoer et al., 2020). However, this growth is not parallel with good waste management. The solid waste performance carried out by the Gunungkidul Regency government is still considered low according to the waste management balance sheet (Gunungkidul, 2019). The Cleanliness and Landscaping Technical Executor Unit (CLTEU) has only served coastal tourism areas and a few markets in the SZGR. Environmental injustice and treatment gaps in waste management occur in the SZGR because the CLTEU does not provide similar waste services in residential areas (Kubanza et al., 2017). This condition causes the SZGR's rural areas to be vulnerable to environmental damage, public health, and aesthetic degradation of the rural environment caused by poor solid waste management.

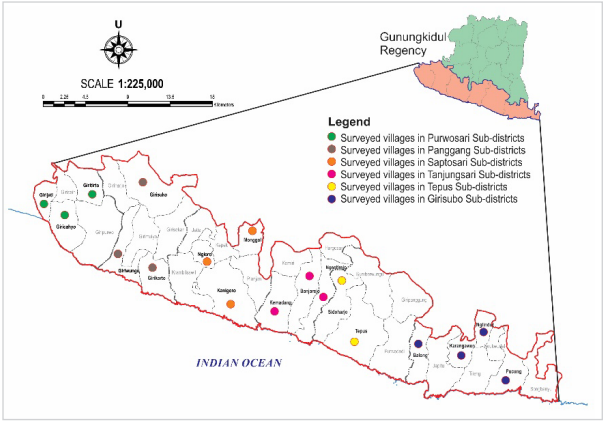
The development of an ideal waste management system requires an understanding of the practices applied to find problems and accurate estimates. The description of the relationship aspects of the waste management system will identify weaknesses in its implementation. Several studies provide empirical data on rural solid waste management in developing countries and deserve attention (Han et al., 2018; Wang et al., 2018; Patwa et al., 2020). Based on the above conditions, the purpose of this study is to provide an empirical description as a form of evaluation and identification of problems with the solid waste management system in the SZGR.

Materials and Methods

Study area

The research location is in the southern zone of Gunungkidul Regency which is administratively located in Purwosari, Panggang, Saptosari, Tanjungsari, Tepus, and Girisubo Sub-districts. The geographical location of the SZGR is in a hilly karst area with a topography of hilly slopes and an average height of 299 meters above sea level. The SZGR is barren due to the high porosity of the karst hills' surface and the difficulty of finding a surface water flow. The typical karst hilly soil is Mediterranean red, and latosols are poor nutrients (Gunungkidul, 2020a). However, the local people in this area live as farmers of secondary crops, rice, coconut, rubber and coffee. Based on the Central Statistics Agency data, all administrative areas in the SZGR have the status of the village. The 18 sample villages were randomly selected to represent the broad study area. The sample villages were selected based on population density and were willing to be surveyed during a pandemic. Villages that were not willing to be surveyed were changed to other villages. The distribution of villages can be seen in *Fig. 1*.

Fig. 1. *Study area and villages samples in the SZGR*



Research samples

This study explores as detailed information as possible by conducting interviews with various stakeholders to avoid bias. The interviewees' selection was performed using purposive sampling with the capacity and function in waste management as the criteria. The CLTEU Head and Environmental Capacity Development Head becomes an interviewee to represent the waste service organization from Environmental Service. The village head or the officer in charge of solid waste became a resource person in each village sample. Community grouping is carried out based on the recipients of waste services at tourist sites and residential sites that do not receive waste services. The interviewee from each community group was selected randomly with the criteria above 18 years of age and the ability to answer questions. See *Table 1* for more detail.

Table 1. *Number of sources*

Interviewees	Quantity	Code
Locals		
Locals in residential area	18	LR.1-18
Locals in coastal tourism area and market	4	LT.1-4
Organization		
Head of The Cleanliness and Landscaping Technical Executor Unit (CLTEU)	1	O.1
Head of Environmental Capacity Development (ECD)	1	O.2
Head of Independent Waste Management Network	1	O.3
Government		
Village headman	18	VH.1-18
Total	43	

Structured interview guide

The structured questions were divided into 6 sections for 20 questions. *Table 2* presents a summary of the focus of the questions asked about the waste management system, including operations, regulations, institutions, financing, and community participation. The questions asked were tailored to the interviewee's position in each organization.

Table 2. *Structured interview guide*

No.	Section	Focus of questions
I	Interviewee's Information	Organization type; Position in organisation
II	Operational	Operational waste management includes storage, collection, transportation, and final processing; Service area and frequency; Amount of waste transported
III	Regulation	Applicable regulation; Rule enforcement
IV	Institutional	Organizations responsible for waste management; Quantity of human resources; Total waste infrastructure; Presence and number of community-level organisations
V	Financing	Source of funds for waste management; Amount of levy charged
VI	Community participation	Training/socialisation conducted by the government; Participation in the waste bank program; Implementation of the concept of reducing waste through 3R

Data collection

Data collection was carried out for 4 months, from December 2020 to March 2021. The research permit was submitted to the Gunungkidul Regency Environmental Service. The Head of the CLTEU was the first to be interviewed. The operational aspects of solid waste services carried out by the CLTEU are clearly illustrated from this interview. Data on regulation, financing and institutional aspects were facilitated by the Head of the Environmental Capacity Development Division. In addition to interviews, relevant documents and reports from the environmental service were available for collection. Subsequent discussions were held with 18 village governments and representatives of community groups in the sample villages. Operational and community participation aspects were successfully explored through this interview. The Head of the Independent Waste Management Network was the last person to be interviewed. This interview produced data related to community institutions and participation.

After the interview, direct observation and documentation of the existing condition of the waste management system were carried out independently. Observations were made in the residential and tourist attractions of the 18 sample villages. Researchers observed and documented the condition of solid waste infrastructure, operational patterns of waste management, and field findings considered relevant to the research topic.

Data analysis

Interviews were conducted for no more than 30 minutes. Forty-three structured interview recordings were transcribed into word processing software. The transcript data were then analysed qualitatively using the Atlas.ti 8 software. Secondary data were processed into graphics using the Origin 2018 software. The analytical framework presented the aspects of the waste management system according to the Indonesian National Standard (INS) 3242:2008, namely operational, regulation, institutional, financing, and community participation. Several quotes that were considered significant from every aspect of the waste management system are presented in this study. Primary and secondary data in text, tables, graphs, and images were analysed with a qualitative descriptive method.

Results and Discussion

Demographic characteristic in the SZGR

The SZGR is karst hills with a 530.5 square kilometres area inhabited by 182,642 people. The population trend is increasing every year, with the average growth rate of 1.11% in 2019 (see *Fig. 2*). The female population is by 4% larger than the male population, which is 89,729 people. Most of the people in the SZGR completed their education at a senior high school (see *Fig. 3*). More than 70% work as farmers working on nutrient-poor soils typical of karst hills.

Fig. 2. . *Population and growth rate in the SZGR*

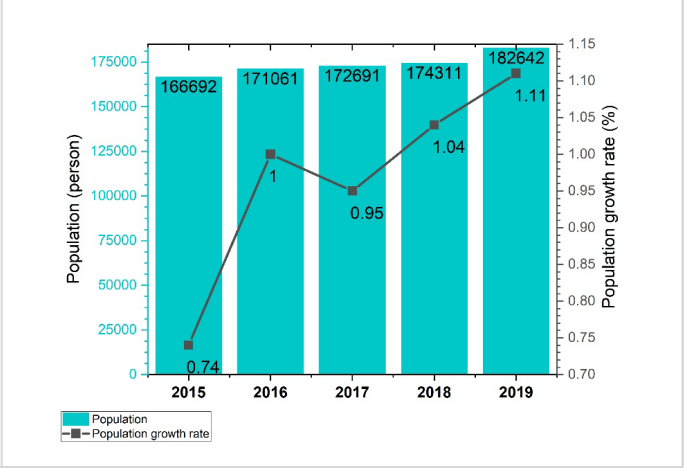
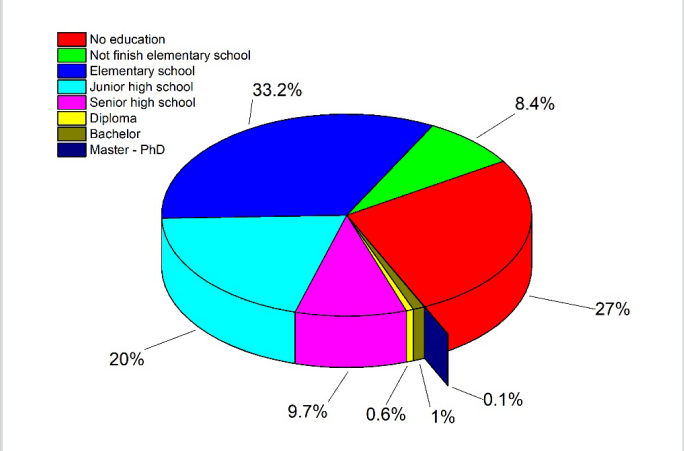


Fig. 3. . *Population based on the education level*

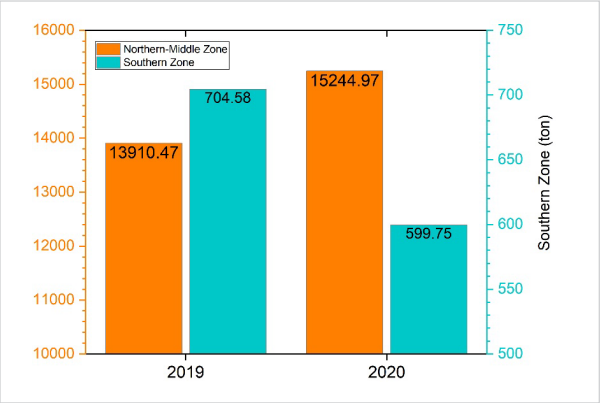


Waste management system in the SZGR

The average waste generation in Gunungkidul Regency is 0.58 kg per person per day. In 2018, a total of 356,745.57 kilograms of waste per day was generated (Gunungkidul, 2019). The CLTEU noted that in 2019 and 2020 waste disposal to the Wukirsari landfill was 30,459.78 tons. The volume of waste originating from the southern zone was 4.8% of the total waste in 2019 and decreased by 104.83 tons or 4% in 2020 (see *Fig. 4*). This amount of waste does not describe the overall waste generation by residents' settlements in the southern zone because the CLTEU only serves coastal tourist areas and several markets.

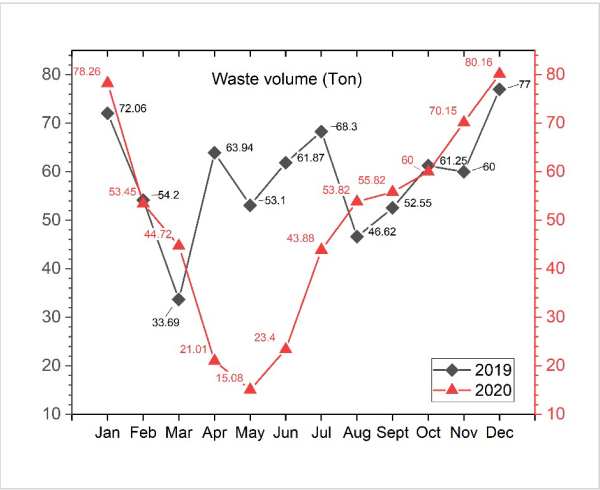
The waste volume from the SZGR experienced a significant decrease in March 2020, where it increased in the previous year.

Fig. 4. *Population based on the education level*



The volume decreased due to a Decree of the DI Yogyakarta Governor regarding the Determination of the Status of Emergency Response to the COVID-19 Disaster providing restrictions on large-scale activities starting on March 20, 2020, until May 29, 2020, which then was extended until June 30, 2020. During this period, the tourist visit to the coastal area was limited. It was seen that waste volume transported to the Wukirsari landfill decreased and began to increase again in June 2020 until the end of the year (see *Fig. 5*). This condition shows that tourists contributed to increasing waste volume in the southern zone. Lunag et al. (2019) state a pattern of increasing waste in tourist areas caused by tourists, especially during the holiday season and weekends.

Fig. 5. *Waste entering Wukirsari landfill from the SZGR (2019–2020)*



Gunungkidul Regency produces 64.1% organic waste and 35.9% inorganic waste. According to Gunungkidul (2019), organic waste such as food scraps and yard waste comes from restaurants, hotels, hospitals, coastal tourist areas, and markets. The large proportion of organic waste compared with recycled waste is typical of rural areas (Han et al., 2019), which comes from households, agriculture, and animal waste (Taghipour et al., 2016; Patwa et al., 2020; Li et al., 2021).

Operational aspect

Solid waste management operational techniques include a series of storage, collection, transportation, processing, and final waste disposal activities (Badan Standarisasi Nasional, 2002). The waste management operation in the SZGR is divided into residential areas and coastal tourism areas that receive waste services from CLTEU. The depiction in both areas will provide a complete picture of the implemented waste management operations.

SZGR locals have not implemented good and correct waste management operations. The household provides trash bins to put together waste without a separation process in the containing stage (see *Fig. 6*). Some common treatments afterward include burning waste in backyard pits, dumping it on plantations, and piling it up with cow dung to become fertilizer. Similar conditions also occur in non-residential waste sources such as offices, shops, restaurants, markets, and other public facilities. It is common to discover conventional waste management in rural areas of developing countries (Nxumalo et al., 2020). According to Patwa et al. (2020), open dumping has become a problem in rural areas, and 78% of the population use it for solid waste collection.

> *Waste generated from the community, both households and shops, is managed by burning. Some is taken to agricultural land far from home or in the hills to be burned, some is immediately burned when cooking because they still use a stove and wood.* [code LR.18 – Pucung village locals].

> *In general, household waste management in Giricahyo Village is collected first for a few days and then disposed of on their respective agricultural lands. Some of the garbage that is thrown away is burned immediately, but some is just piled up to become fertilizer for the plants around it. [*code LR.2 – Giricahyo village locals].

Fig. 6. *Waste storage in residential and local markets*

The local authority does not provide waste disposal facilities such as open containers or temporary shelters in residential areas. This condition encourages locals to throw waste indiscriminately into karst recesses found in hills and unmanaged fields (see *Fig. 7*). Such landfills can be found in the Kemadang, Nglindur, Tepus, and Girisubo Sub-districts. The solid waste that covers the karst pit has the potential to cause flooding. Wang et al. (2017) state that illegal dumping contaminates water, soil, and the surrounding environment. According to Wang et al.'s (2018) research, people will be encouraged not to litter if there is infrastructure and organized waste disposal in their environment. Therefore, the Government needs to facilitate temporary shelters or containers to control waste disposal. They should consider the distance to residential and transportation costs to the landfill in planning the waste infrastructure placement in rural areas (Wang et al., 2017).

> *Balong village has many karst overdrafts and holes (luweng). The karst overdrafts and luweng are then used by the community to dispose of garbage.* [code LR.15 – Balong village locals].

> *Not all residents throw garbage illegally in luweng, but the current condition is that the place already has a large quantity of garbage and is wide along the road.* [code LR.13 – Tepus village locals].

The CLTEU of the Gunungkidul Regency Environmental Service is responsible for waste service in coastal tourist areas and several markets. The CLTEU provides open containers to store waste. The waste source using a trash can store waste, and the janitor collects and transports it to the closest container. The garbage storage in this area does not apply waste segregation. CLTEU officers sort waste at containers or at a market's temporary shelter. Two trucks are prepared to transport the waste contained in the beach containers and market temporary shelter. Waste transportation is not carried out evenly every day due to the lack of a fleet, different volumes of waste generation on each beach, and the large area to be served. The janitors will inform the condition of the waste container in the beach and markets to the CLTEU so that

Fig. 7. *Illegal dumping in karst pits and roadside*

the fleet sent can work effectively. The fully-loaded truck then heads straight to the Wukirsari landfill. The CLTEU apply a direct communal pattern in the tourism and market areas, based on the collection and transportation process (see *Fig. 8*).

Tourism waste is not too much of a problem, because the garbage on the beach has been provided with a container and will be transported by the CLTEU Environmental Service on a regular basis. [code LT.1 – Restaurant owner].

Waste in the coastal area is the responsibility of the janitor from the CLTEU Environmental Service so that every few days there is a garbage truck that picks up garbage to take it to the Final Disposal Site. [code LT.2 – Restaurant owner].

Fig. 8. *Direct communal pattern in the tourism and market areas*

Regulation

The waste management regulations applied in the SZGR are at the regional and regent levels (see *Table 3*). The locals generally do not know the existence of waste management regulations in force even at the village level due to a lack of socialization. The village government enforces regulations by giving warnings for littering and putting up signs at illegal landfills. In the absence of binding regulations and sanctions applied, the village government's efforts will be useless. Regulations are a prominent instrument in regulating rights and obligations, disputes, and the basis for each waste stakeholder in managing solid waste. Regulations that apply in rural areas will provide a legal umbrella for the community to carry out waste management responsibly (Wang et al., 2017). People do not feel they have committed a violation when disposing of waste in any place due to no application of solid waste management regulations and firmness of sanctions.

The village government and some communities have carried out various social sanctions, imposed fines, installed banners, and even made reports to the authorities. In fact, till today the waste accumulation on illegal dumping has not decreased because of the lack of strict supervision, and some people considering this to be a normal act and not a big problem. [code VH.17 – Nglindur Village Head].

Sanctions, reprimands, and the installation of banners at the illegal dumpsites have been carried out even though they have not made any real changes. [code VH.13 – Tepus Village Head].

Table 3. *Waste management regulations in Gunungkidul Regency*

No.	Regulations	Concern
1	Gunungkidul Regency Regional Regulation Number 6 of 2011	Gunungkidul Regency Spatial Plan 2010–2030
2	Gunungkidul Regency Regional Regulation Number 10 of 2012	Waste management
3	Gunungkidul Regency Regional Regulation No. 13 of 2012	Garbage/Cleaning Service Fee
4	Gunungkidul Regency Regional Regulation Number 04 of 2016	Regional Medium-Term Development Plan 2016–2021
5	Gunungkidul Regent Regulation Number 64 of 2016	Position, Organizational Structure, Duties, Functions, and Work Procedures of the Environmental Service
6	Gunungkidul Regent Regulation Number 51 of 2018	Policies and Strategies of Gunungkidul Regency in the Management of Household Waste and Types of Household Waste

Institutional aspect

Solid waste management requires institutions that come from government and community elements. Article 15 of the Gunungkidul Regency Regional Regulation No. 10 of 2012 has regulated a waste management agency tasked with reducing and handling waste. In addition, the local government also facilitates waste management institutions up to the village level according to the needs and allocation of the area. The Gunungkidul Regency Environmental Service (GRSE) acts as supporting elements of the local government in the management and control of environmental impacts in the Gunungkidul Regency. Following the GRSE organizational structure, waste management is the responsibility of the Pollution Control and Capacity Development Division (PCCDD) and the Cleanliness and Landscaping Technical Executor Unit (CLTEU). The CLTEU's main job is to run technical waste management. The CLTEU is equipped with human resources and infrastructure to serve coastal tourist areas and several markets in the SZGR.

The environmental service was only formed in 2017; in the beginning its duties were only in the form of coordination, so that currently its performance has not been seen or there are still minimal services. We have not been able to serve the entire southern region due to the limited personnel and equipment we have. [code O.1 – Head of the CLTEU].

Our budget allocation is limited; it is difficult for us to serve the community well. [code O.2 – Head of the ECD]

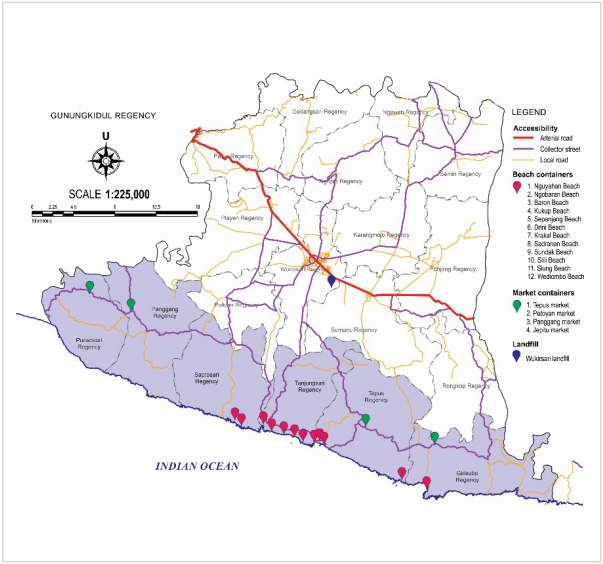
Table 4. *Waste infrastructure in the SZGR*

No.	Item	Specification	
		Type	Amount
1	Fleet	Dump truck 6 m^3	1 unit
2		Arm roll	1 unit
3		Three-wheel carrier	4 unit
4	Human resources	Freelance and civil servants	36 persons
5	Waste storage	Open container 4 m^3	12 unit
6		Market temporary shelter	4 unit

Source: CLTEU, 2020

The infrastructure and staff resources provided by the CLTEU have not been able to accommodate waste services in coastal tourist areas in one day. The area coverage, hilly topographical conditions, narrow and winding roads, and beach and markets open container points are far from Wukirsari landfill, making it difficult for field officers to perform the collection and transportation phase (see *Fig. 9*). Remote villages can implement decentralized collection (Han et al., 2015) and design more optimal waste transport networks and routes (Wang et al., 2017).

Fig. 9. *Container distribution in the SZGR and landfill position*



The solid waste management institution at the community level is a waste bank. There are ten waste banks in the SZGR or about 6% of the total 161 registered waste banks in Gunungkidul Regency (Gunungkidul, 2020b). Waste banks in the SZGR are spread out in the Districts of Saptosari, Tanjungsari, and Panggang. The Government of Tanjungsari and Panggang Districts discontinued the waste bank program due to a lack of local's enthusiasm. The operation of the waste bank in the SZGR encountered several obstacles, starting from the lack of community participation as customers, the collection of selling-value waste by scavengers constrained by the distance and topography of the karst hills, and the difficulty of the waste bank in selling handicraft products from recycled waste.

Financing

Waste management operational aspect requires financial support from the government and the community as a waste source. That funding is used for waste facilities construction such as communal trash bins, waste shredder equipment, and waste officer's salaries. Wang et al. (2017) state that rural waste services need sufficient funding to operate effectively. One source of financing can come from the waste retribution charged to the community receiving waste services such as tourist areas and markets. The amount of levy varies between the two locations varies from 10,000 to 40,000 IDR per month.

> *As a tourist centre village, the village income is high to support the availability of supporting facilities for the community. The village government's attention to the waste problem is a priority, especially in the tourism area. Residence on the main road of this village has cleaning staff to transport waste, although in small scope and not comprehensive.* [code VH.10 – Kemadang Village Head].

> *We include the procurement of waste counting equipment into the village fund budget, but it can only be realized next year.* [code VH.2 – Giri Cahyo Village Head].

The village government needs to pay attention to environmental protection efforts even though they have not received waste services from the CLTEU in the residential area. Village funds from the Ministry of Village, Development of Disadvantaged Regions and Transmigration (MVDDRT) can be an alternative in financing. Panggang, Purwosari, and Girisubo sub-districts use village funds to facilitate equipment for solid waste management. The waste infrastructure development will be the capital asset for the village to start waste services in settlements. Levy can be charged in the future to the locals to increase financing. The MVDDRT decree No. 11 of 2019 explains that the village funds are permitted to fund the waste management needs in the form of infrastructure and the preparation of human resources. This opportunity needs to be addressed by increasing cooperation between the government and the locals to form good synergy in the financial aspect.

Community participation

According to the Regional Regulation of Gunungkidul Regency No. 12 of 2012, the role of the community is in the form of being active in maintaining and carrying out waste management operations and playing a role in the planning stage to carry out control functions in their environment. In more detail, the community role is in the form of waste sorting, waste processing with the Reduce Reuse Recycle (3R) concept, paying retribution, complying with regulations, protecting the environment, and playing an active role in waste management socialization (Badan Standarisasi Nasional, 2008).

Based on the description above, the population in the SZGR has not yet played an active role in waste management. It looks in the operational aspect where the community has not done waste sorting and implementing the 3R concept. Community participation in the waste bank program as administrators and customers is relatively small compared with the number of villages in the SZGR. However, people who have businesses in tourist areas and markets comply with the payment of the levy charged for receiving waste services from CLTEU.

> *We hope that there will be a third party who wants to go directly to provide socialization or assistance in waste management. Real steps towards the community are very well received by the Pucung Village government and provide support if they are going to go directly into the community.* [code VH.18 – Pucung Village Head].

> *Basically, the community wants to participate as long as it is socialized regarding regulations, there is training, there is assistance with tools, and guarantees that the processed waste is absorbed, and there needs to be a facilitator per village.* [code O.3 – Head of Independent Waste Management Network].

People in the SZGR want to participate in waste management in their environment. Barriers to public intentions are due to a lack of correct information. The community needs socialization and assistance so that they can be independent in waste management. The socialization held by the government is constrained by the small budget allocation so that it has not been able to reach the SZGR. The low level of knowledge about

proper waste management is due to the lack of socialization and training facilitated by the government (Babaei et al., 2015). The absence of waste infrastructure services in residential areas causes less-knowledgeable people to process waste conventionally (Wang et al., 2018).

Conclusions

Economic and population growth occurs rapidly in developing countries. This condition triggers an increase in the amount of waste produced every day. Unmanaged waste can cause environmental and human health problems. Unfortunately, the attention to the waste problem is often in the urban areas, even though the rural areas experience similar conditions. There is less documentation of operational, regulation, institutional, financial, and community participation aspects in rural waste management systems. Understanding the existing conditions of rural waste management systems provides an overview of the future potential impacts and designing an appropriate method.

The SZGR rural solid waste management system has various weaknesses in every aspect. Waste management operations carried out by waste sources still apply conventional methods by burning, stockpiling, and dumping carelessly. Although Gunungkidul Regency has regulations for waste management, the village government in the SZGR does not implement them properly. It causes no legal basis for village government in implementing waste management or acting against violations occurs. The institution in charge of solid waste services at SZGR is the Environment Agency, with the CLTEU as the technical implementer. The CLTEU itself has limited personnel and fleet, and it can only serve and collect user fees in tourist areas on the coast and some markets. SZGR has a community-based organization in waste management called a waste bank. The waste bank has difficulty increasing the number of participants and selling processed waste products. Community participation in waste management can be said to have not run optimally. It can be seen based on operational aspects and participation in waste bank programs. This condition occurs because of no regulations governing solid waste management in SZGR, socialization related to waste management, and the absence of waste services in residential area.

The field survey is an ideal method for documenting the condition of waste management systems in the rural area of SZGR. This study presents the identification of the problems from every aspect as an evaluation to improve the solid waste management systems. Selecting the ideal waste management method and technology in SZGR can be a future research topic. But before that, it is necessary to explore the waste characteristics and identify the community's desire to participate in waste management.

Acknowledgements

The author would like to thank the Head of the Technical Implementation Unit for the Cleanliness and Gardening of the Gunungkidul Regency Environmental Service for facilitating all the needs in data collection. The authors also thank the village head at the research location, who has permitted to conduct field research during the pandemic.

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